

# SCIOTO RIVER WATERSHED, OHIO

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## LETTER

FROM

SECRETARY OF AGRICULTURE

TRANSMITTING

A SURVEY REPORT, DATED OCTOBER 1950, TOGETHER  
WITH ACCOMPANYING PAPERS AND ILLUSTRATIONS  
OF THE SCIOTO RIVER WATERSHED IN OHIO, MADE  
UNDER THE PROVISIONS OF THE FLOOD CONTROL  
ACT, APPROVED JUNE 22, 1936, AS AMENDED AND  
SUPPLEMENTED



MARCH 31, 1952.—Referred to the Committee on Public Works  
and ordered to be printed with illustrations

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UNITED STATES  
GOVERNMENT PRINTING OFFICE  
WASHINGTON : 1952

SCIO TO RIVER WATERSHED, OHIO

LETTER

FROM

SECRETARY OF AGRICULTURE

TO

A STATE REPORT DATED OCTOBER 15, 1907,  
WITH ACCOMPANYING MAPS AND ILLUSTRATIONS  
ON THE SCIO RIVER WATERSHED IN OHIO, MADE  
UNDER THE PROVISIONS OF THE WOOD CONSERVATION  
ACT, APPROVED JULY 1, 1906, AS AMENDED, AND  
SUBMITTED.



MADE IN 1907.—Revised and corrected by the Committee on Public Works  
and ordered to be printed in illustration

UNITED STATES  
GOVERNMENT PRINTING OFFICE  
WASHINGTON : 1912

## LETTER OF TRANSMITTAL

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DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SECRETARY,  
*Washington, March 19, 1952.*

THE SPEAKER OF THE HOUSE OF REPRESENTATIVES.

DEAR MR. SPEAKER: I am submitting herewith a survey report, dated October 1950, together with accompanying papers and illustrations of the Scioto River watershed in Ohio, made under the provisions of the Flood Control Act approved June 22, 1936, as amended and supplemented.

I recommend that the Secretary of Agriculture be authorized to carry out the program of runoff and water-flow retardation and soil-erosion prevention proposed in this report.

Enclosed are comments received from the Governor of Ohio and interested Federal agencies.

The Bureau of the Budget, in its letter of March 5, 1952, advises that there is no objection to the submission of this report to the Congress. The Bureau further advises that it is in agreement with the objective contemplated in the report of carrying out measures designed to retard floods and prevent soil erosion, and that this objective is particularly desirable from the point of view of coordination of upstream measures with the flood-control programs of the Corps of Engineers. A copy of the letter from the Bureau of the Budget is enclosed.

Sincerely,

CHARLES F. BRANNAN,  
*Secretary.*

LETTER OF TRANSMITTAL

Department of the Interior

Washington, D. C.

June 1, 1901

The Honorable Commissioner

The following is a list of the papers and documents which have been received from the various sources mentioned in the accompanying letter. These papers and documents are of great value and interest, and are being forwarded to you for your consideration and use. The papers and documents are as follows:

1. A copy of the report of the Commissioner of the General Land Office, dated June 1, 1901, on the subject of the land grant to the State of California, under the Act of March 3, 1855, for the purpose of establishing a State University.

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CHARLES F. BRADLEY

Commissioner



## SCIOTO RIVER WATERSHED, OHIO

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### LETTER FROM THE BUREAU OF THE BUDGET TO THE SECRETARY OF AGRICULTURE

EXECUTIVE OFFICE OF THE PRESIDENT,  
BUREAU OF THE BUDGET,  
*Washington 25, D. C., March 5, 1952.*

The honorable the SECRETARY OF AGRICULTURE.

MY DEAR MR. SECRETARY: This will acknowledge receipt of Acting Budget Officer J. L. Wells' letter of June 8, 1951, requesting advice as to the relationship to the President's program of the proposals contained in your Department's report entitled "Interim Survey Report, Scioto River Watershed, Ohio."

Erosion, floodwater, and sediment damages occurring in the Scioto River watershed are estimated to average \$3,661,659 annually. The principal losses, estimated to average \$2,073,967 annually, are caused by sheet erosion and inundation of agricultural land. Sediment damages to reservoirs, drainage ditches, transportation facilities, etc., are estimated at \$1,189,522. Inundation of nonagricultural areas accounts for the balance of the estimated damage. (\$398,170).

It is proposed to alleviate these damages and to realize extensive associated benefits by installing a number of interrelated and interdependent soil and water conservation and control measures during a 20-year period. These measures, applied in proper combination with other soil and water conservation practices and measures, would constitute a basic system of soil and water conservation in accordance with needs and capabilities of the land in the Scioto River watershed. Educational assistance and technical services are also recommended as a part of the proposed program.

The estimated cost of the recommended program, based on 1949 prices, is \$20,307,990. The Federal Government would be expected to expend \$11,615,210 of the total cost, and local interests would contribute \$8,692,780 or its equivalent in labor, materials, equipment, land easements, and other assistance in lieu of cash payments. Operation and maintenance of the recommended works of improvement are estimated to cost \$4,729,872 annually, of which the Federal Government would provide \$102,340, and \$4,627,532 would be borne by landowners and local interests.

It is estimated that the recommended watershed program, if installed as planned and maintained adequately, will yield average annual benefits evaluated at \$19,997,867. Reduction in erosion, inundation, and sediment damages is estimated at \$1,669,831, while conservation benefits are estimated at \$18,328,136. The conservation benefits would result mainly from the provision of farm waterways, terraces, pasture and woodland development, and other conservation measures.

The total average annual costs of the recommended land-treatment measures are estimated at \$5,241,445. Since prices are expected to vary during the 20-year installation period, both benefits and costs were adjusted to anticipate future price levels by applying indexes provided by the Bureau of Agricultural Economics. The effect of this adjustment or alternate evaluation is to reduce monetary values of both benefits and costs. Thus, the average annual benefits are adjusted to \$11,986,342 and the costs, on the same basis, to \$3,482,103. This adjustment results in a revised benefit-cost ratio of 3.4 to 1.0 for the recommended program.

The report has been reviewed by the Governor of Ohio and also by the several concerned Federal agencies, in accordance with policies and procedures for distribution and coordination of reports as adopted by the Federal Inter-Agency River Basin Committee. The views expressed are generally favorably to the proposed program, with suggestions limited to considerations that could be resolved cooperatively by the concerned agencies or local interests during the periods of planning and installing the watershed works of improvement.

The work envisioned in the report constitutes principally open-land, farm, and woodland improvement measures which will produce high conservation benefits, accruing mainly to landowners and farm operators in the form of increased returns due to improved practices. The program recommended also includes an intensification, acceleration, and adaptation of land treatment activities already in progress under going programs of the Department of Agriculture. These include such programs as the conservation and use program, authorized by the Soil Conservation and Domestic Allotment Act, approved February 29, 1936, as amended; the Soil Conservation Service's program of assistance to districts and other cooperators, authorized by the act of April 27, 1935; and State and private forestry cooperation, pursuant to the act of August 25, 1950, sections 1 through 5 of the act of June 7, 1924, and acts supplementary thereto.

The Bureau of the Budget is in agreement with the objective contemplated in the report of accelerating land-treatment measures and installing structural measures designed to retard floods and prevent soil erosion. This objective is particularly desirable from the point of view of coordination of upstream measures with the flood-control programs of the Corps of Engineers.

The measures contemplated to implement the proposed program may be grouped into two broad categories—land-treatment measures and structural measures. The Bureau of the Budget is of the opinion that installation of the structural measures (shown in table 3, p. 14, of the report as "Stabilization of water-disposal systems," "Diversions," "Stabilizing and sediment-control structures," "Upstream floodwater retarding structures," and "Tributary channel improvement") should properly be authorized under the Flood Control Act, as amended and supplemented. The Bureau also believes that the land-treatment measures set forth in the report, since they are largely an acceleration of existing programs of the Department of Agriculture, should be financed under appropriations other than that for the Flood Control Act. This would avoid confusion in the presentation of the Department's budgetary program, since many of the current land-treatment programs of the Department have the objective of runoff and water-flow retardation and the prevention of soil erosion. To the

extent that the acceleration of land-treatment measures under existing authorities is not possible, we urge that adequate authorities for such acceleration be sought through amendment of those basic authorities.

Your staff, on the other hand, believes that the Department cannot properly meet its responsibilities under the Flood Control Act unless the full program envisioned in the report is authorized under that act. Your representatives, however, agreed that appropriations for land treatment phases implementing the program recommended in the report, upon approval by the Congress generally on the basis as submitted, would be sought as additions to going program appropriations of the agencies carrying on the work. Funds for structural works or measures would still be requested under the appropriation "Flood control." The total obligations for land treatment and structural measures in each authorized flood-control project area could, of course, be shown in a summary table to be presented in the program and performance section of the annual budget document.

Subject to the above understanding as to the method of presenting the budget for flood-control programs, there would be no objection to the submission of the proposed Scioto River watershed flood control survey report to the Congress. In the event the report or any modification thereof is approved by the Congress, submission of requests for appropriations must be justified in accordance with the policy set forth in the President's letter of July 21, 1950, which directed that all civil public works be considered with the objective, as far as practicable, of deferring, curtailing, or slowing down those projects which do not directly contribute to national defense or to civilian requirements essential to the changed international situation, or as may later be modified.

In submitting the Department's report to the Congress, it will be appreciated if you include a copy of this letter.

Sincerely yours,

ELMER B. STAATS,  
*Assistant Director.*

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LETTER FROM THE CHIEF OF ENGINEERS TO THE SECRETARY  
OF AGRICULTURE

DEPARTMENT OF THE ARMY,  
OFFICE OF THE CHIEF OF ENGINEERS,  
*Washington, September 27, 1951.*

The honorable the SECRETARY OF AGRICULTURE.

DEAR MR. SECRETARY: In accordance with request from the Under Secretary of Agriculture, enclosing for my information and comment the Department of Agriculture's survey report on the Scioto River watershed, Ohio, I am pleased to submit the following comments.

The report recommends that the Federal Government undertake in the Scioto River Basin an extensive watershed improvement program involving runoff and water-flow retardation and soil-erosion prevention. The total estimated installation cost of the program, based on 1949 prices, is \$20,307,990, including \$11,615,210 Federal, \$1,914,707 non-Federal public, and \$6,778,073 private. The non-Federal participation may be largely in labor, materials, equipment,



land, easements, rights-of-way, and other contributions in place of cash contributions. The estimated annual cost of operating and maintaining the completed program is \$102,340 Federal, and \$4,627,532, or the equivalent, to local interests. Estimated average annual benefits total about \$19,998,000 and include reductions in erosion, sediment, and overflow damages and benefits from conservation and from increased bottom-land production. Based on an adjustment to prices and costs expected in the period 1955-65, the ratio of average annual benefits to average annual costs is stated in the report to be 3.4 to 1.0.

The plan for watershed improvement in the Scioto Basin presented in your report appears to have been planned in cognizance of and to supplement the flood control program in that basin authorized for construction by the Corps of Engineers, and I feel that any minor adjustments to which I shall refer later and which may become necessary, as watershed improvement and stream control plans are developed in detail and put into operation, can be made by coordination between our agencies on a mutually satisfactory basis as the occasion arises.

The watershed management portions of your recommended plan, which contribute the great bulk of the program insofar as estimated cost is concerned, appear valuable in themselves as measures to conserve and improve the soil and lands of the basin, and the report states that they would reduce by 46 percent the probable sedimentation in Paint Creek, Big Darby, and Deer Creek Reservoirs which are a part of the approved flood-control and water-conservation plan for the basin. While we are unable to verify this exact figure, it appears that measures proposed would have a substantial effect in reducing sedimentation and would, therefore, enhance the effectiveness of the flood-control reservoirs. I have no comment regarding the cost or estimated benefits of this part of the program.

The remainder of the program recommended in your report, involving less than 10 percent of its estimated cost, includes about 600 stabilizing and sediment-control structures and water-flow detention features, controlling watershed areas varying from 40 to 200 acres; some 250 miles of tributary channel improvement involving debris removal, realignment and bank protection; and three floodwater retarding structures. These provisions and structures are more immediately related to the flood-control plans of the Corps of Engineers in this basin.

The procedure followed in your investigation and the resulting data in your report do not permit me to make specific evaluation of the adequacy, effect, cost, and economics of these structures and provisions. In general, however, it does not appear that they will conflict with or adversely affect the flood-control program of the Corps of Engineers. The aggregate storage involved in, and are a controlled by, the 600 stabilizing and sediment control structures will be relatively small with respect to the total flood-producing area of the basin; and their influence upon major flood-storage requirements will be small accordingly. As nearly as can be determined, the tributary channel improvements are planned for local effect and benefit. In the aggregate, however, the improvement of flood-carrying capacities of small upstream channels may have some significant effect upon downstream flood discharges and problems. I

am sure that you recognize the necessity for coordinating your detailed plans for these provisions with downstream flood-control projects and requirements.

The three floodwater-retarding reservoirs represent a very small part of the cost of your plan of improvement and will control only about 15 square miles of the 6,500 square-mile Scioto Basin. They are obviously local in effect and appear to be waterflow-retarding structures rather than reservoirs which will control major floods. In the event, however, that your plan of improvement is authorized by Congress and your detailed investigations after authorization indicate the desirability of a substantial increase in the size of these dams, or in areas controlled, it is believed that such a modification should result from a joint investigation by our two agencies and a further recommendation to Congress.

The Rocky Fork Reservoir project mentioned in the report as being under construction was selected for flood control and water conservation by the Chief of Engineers under the comprehensive authority for the Ohio River Basin in the Flood Control Act of June 28, 1938. Although a definite project report was prepared on the project, which was to be developed jointly by the Federal Government and the State of Ohio, no Federal funds have as yet been appropriated for construction, and the State of Ohio is proceeding alone with construction of the reservoir for conservation and recreational development.

I appreciate the opportunity given me to review your report on the Scioto River Basin; and subject to the comments made above for coordinating the program, and the necessity for establishing it on a basis which is sound from an engineering and economic standpoint, I am in accord with the type of program set forth in your report.

Very truly yours,

LEWIS A. PICK,  
*Lieutenant General,  
Chief of Engineers.*

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LETTER FROM THE GOVERNOR OF OHIO TO THE ASSISTANT  
SECRETARY OF AGRICULTURE

THE STATE OF OHIO,  
OFFICE OF THE GOVERNOR,  
*Columbus, May 9, 1951.*

Mr. K. T. HUTCHINSON,  
*Assistant Secretary, Department of Agriculture,  
Office of the Secretary, Washington, D. C.*

DEAR MR. HUTCHINSON: In connection with the interim survey report, Ohio River watershed, Scioto River watershed, Ohio, by H. H. Bennett, Chief, United States Soil Conservation Service, I do not at this time have any comments to offer on it.

I have not had the opportunity of studying with the completeness that I would like to the general subject involved and, hence, I do not feel qualified at this time to make any observations.

Sincerely yours,

FRANK J. LAUSCHE.



LETTER FROM THE SECRETARY OF THE INTERIOR TO THE  
SECRETARY OF AGRICULTURE

DEPARTMENT OF THE INTERIOR,  
OFFICE OF THE SECRETARY,  
*Washington 25, D. C., March 26, 1951.*

Hon. CHARLES F. BRANNAN,  
*Secretary of Agriculture, Washington 25, D. C.*

MY DEAR MR. SECRETARY: In accordance with Federal Inter-Agency River Basin procedures, Under Secretary C. J. McCormick transmitted by letter, dated December 20, 1950, for the information and comments of the Department, copies of the Department of Agriculture's interim survey report on the Scioto River watershed, Ohio.

The report recommends a remedial watershed program to reduce surface runoff and erosion, stabilize the soil, and conserve water supplies in the Scioto River watershed, Ohio, at an estimated cost of about \$11,600,000 to the Federal Government and about \$8,700,000, or its equivalent, to local interests, making a total estimated cost of about \$20,300,000 with estimated annual operation and maintenance cost of about \$4,800,000. The benefits-to-costs ratio is given as 3.4 to 1. Measures to accomplish the objectives include woodland protection, adequate fire control and protection from over-cutting and logging damage; woodland establishment and reinforcement; land acquisition; land-use conversion and adjustments in cropping pattern; pasture establishment; terracing; stabilization of water disposal systems; diversions; stabilizing and sediment control structures with floodwater detention features; upstream floodwater retarding structures; and tributary channel improvement.

The Scioto River report is outstanding in the clarity with which the computations of benefits and costs are detailed. The explanations are straightforward and the examples are easy to follow. It is partly because of the clarity of these explanations that it is possible to see more clearly the basic philosophies governing the watershed survey activities in your Department.

The physical situation presented by the Scioto watershed is somewhat different than in the areas covered by reports previously reviewed, particularly in that the most important damages in the Scioto Basin are attributable to sheet erosion. The procedure by which losses due to sheet erosion are evaluated is interesting and appears technically sound. The report would be enhanced somewhat by additional basic data such as information on which the original thickness of top soil was determined for the various soil types, the types of geographic settings of the original soil profiles and the variations in original thickness of topsoil resulting from different slopes and local variations in topography.

The report adopts the philosophy that reduction in damage due to inundation on flood plains can be calculated as a benefit accruing from the program. It is recognized that a flood plain is subject to periodic inundations under natural conditions. This inundation, while accounting for some damage to crops grown on the flood plain, is an important source of channel storage during floods. Reduction of overbank flooding is counted as a benefit, but possible adverse effects from reduced temporary storage of floodwaters might well be noted.

It is noted with particular interest that the need for evaluation of the proposed program is recognized in the proposal to install stream and sediment measuring stations in forest lands. Some consideration might well be given to nonforested areas. Your Department is to be commended for including measures for evaluation of the proposed work as part of the proposed program. However, the \$15,000 requested for such measures is very small. This Department considers such evaluation work very important and recommends a somewhat larger program of evaluation. In furthering such evaluation measures, the Geological Survey of this Department would be happy to cooperate with the Department of Agriculture in any way which seems practical.

The report contains references to basic data such as precipitation and stream-flow records and basic maps, usually with acknowledgment of the sources of these data. Thus, it is evident that this Department contributed indirectly to the report. It would be helpful to us in our review of such reports if the relationship of the Geological Survey of this Department to the report could be given somewhat more specification. Such information would tend to help in determining whether all pertinent data available from the Geological Survey had been made available; also such information, I believe, would be helpful to others and would tend to further assure the soundness of the foundation of the report. Moreover we believe that field offices of the Geological Survey may be able to provide valuable and continuing assistance during the planning and compilation of watershed reports and that expansion of cooperative activities in this regard would be welcomed.

The National Park Service of this Department feels strongly that if the recommendations presented in this report are implemented, there will be a definite benefit to the Mound City Group National Monument, just above Chillicothe, Ohio.

The report indicates that review has been obtained from field offices of concerned Federal agencies in accordance with Federal Inter-Agency River Basin Committee procedures. Through an inadvertence, the Fish and Wildlife Service of the Department was not consulted in course of preparation of this report. That Service's review has, of necessity, been quite superficial as their field staff has not had the opportunity to examine the sample land areas studied by the Department of Agriculture. The Fish and Wildlife Service does, however, have familiarity with the reservoir sites of Corps of Engineers' projects in the basin.

It appears that the recommended program will be of considerable benefit to wildlife in general. Some 767 miles of multiflora rose fence will be included as a part of the farm fencing system and strip cropping and terracing are recommended for much of the agricultural acreage.

Little information appears to be available concerning the 597 upstream floodwater detention structures but these are quite small in size and many of them apparently will be located in gulleys or minor stream courses.

The Department feels that the program as outlined would be definitely beneficial to fish and wildlife. The magnitude of these benefits is difficult to ascertain due to unfamiliarity with most of these specific areas referred to within the basin and the general tenor of the report.

The Department of the Interior endorses this report and feels that the proposed program will be beneficial. We would be pleased to have the Geological Survey of this Department collaborate with the Department of Agriculture in the evaluation of the Scioto River watershed management program. We would also welcome an opportunity for the Fish and Wildlife Service to participate in the detailed planning for this proposed program in order to obtain maximum fish and wildlife conservation benefits consistent with sound watershed management.

Opportunity for review of the report is appreciated.

Sincerely yours,

WILLIAM E. WARNE,  
*Assistant Secretary of the Interior.*

LETTER FROM THE ASSISTANT SURGEON GENERAL TO THE  
SECRETARY OF AGRICULTURE

FEDERAL SECURITY AGENCY,  
PUBLIC HEALTH SERVICE,  
*Washington 25, D. C., March 20, 1951.*

HON. CHARLES F. BRANNAN,  
*Secretary of Agriculture, Washington 25, D. C.*

DEAR MR. SECRETARY: Pursuant to the policies and procedures established by the Federal Inter-Agency River Basin Committee, we have reviewed the preliminary report furnished by your Department entitled "Scioto River Watershed, Ohio, October 16, 1950 (Report and Appendices 1, 2, 3, and 4)."

The only comment we have concerning this report is that consideration might be given to the effects, if any, to the proposed program in augmenting low-flow conditions in the streams.

A copy of this letter is being furnished the Secretary of the Federal Inter-Agency River Basin Committee for his information.

Sincerely yours,

M. D. HOLLIS,  
*Assistant Surgeon General,  
Associate Chief, Bureau of State Services.*

LETTER FROM THE ACTING CHAIRMAN OF THE FEDERAL POWER  
COMMISSION TO THE SECRETARY OF AGRICULTURE

FEDERAL POWER COMMISSION,  
*Washington 25, March 9, 1951.*

Subject: Scioto River Watershed, Ohio.

HON. CHARLES F. BRANNAN,  
*Secretary of Agriculture, Washington 25, D. C.*

DEAR MR. SECRETARY: The comments herein relative to your Department's interim survey report on the Scioto River watershed in Ohio are made in response to the Assistant Secretary's letter of December 20, 1950. The transmittal of these comments is in accordance with established procedures of the Federal Inter-Agency River Basin Committee.

The survey report recommends a program for runoff and water-flow retardation and soil-erosion prevention for the Scioto River Basin consisting of various land-use practices, woodland controls, channel improvements, upstream retarding structures, and other measures. The program would be developed over a period of 20 years at an estimated total cost of \$20,307,990, of which \$11,615,210 would be borne by the Federal Government, \$1,914,707 by non-Federal public agencies, and \$6,778,073 by private interests. Based on prices expected to prevail during the period 1955-65, the average annual benefits are estimated to be \$11,986,342 and the average annual costs, \$3,482,103. Hence the benefit-cost ratio is computed to be 3.4 to 1.

The Commission staff has reviewed the report of your Department with the primary object of ascertaining whether or not the recommended plan of improvement would affect existing or potential hydroelectric plants or would afford opportunities for the development of hydroelectric power. The staff reports that, except for several small mill installations averaging less than 20 horsepower each, there are at present no hydroelectric developments in the Scioto River Basin. In regard to future power developments that might be made in the basin or along the Ohio River below the mouth of the Scioto, it is considered that such developments would probably derive some benefit from such increases as may be made in low water flows as a result of the measures recommended in the survey report. In regard to opportunities for developing hydroelectric power at works proposed in the survey report, it is the staff's opinion that your Department's program does not present possibilities for developing power at any of the proposed water-retarding structures or in conjunction with the other proposed improvements.

Based upon the above consideration of your report, it is believed that the program of your Department for run off and water-flow retardation and soil-erosion prevention would not conflict with the development of hydroelectric power but would probably be somewhat beneficial in that respect.

Sincerely yours,

THOMAS C. BUCHANAN,  
*Acting Chairman.*







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UNITED STATES DEPARTMENT OF AGRICULTURE

OHIO RIVER WATERSHED  
INTERIM SURVEY REPORT

SCIOTO RIVER WATERSHED  
OHIO

Program for Runoff and Waterflow Retardation and  
Soil Erosion Prevention

Pursuant to the Act approved June 22, 1936 (49 Stat. 1570)  
as amended and supplemented

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UNITED STATES DEPARTMENT OF AGRICULTURE

OHIO RIVER WATERSHED

UNITED STATES WATERSHED

SCOTTS RIVER WATERSHED

OHIO

Report for Runoff and Water Use in the

Scotts River Watershed

Presented to the Agricultural Research Service

by the Agricultural Research Service

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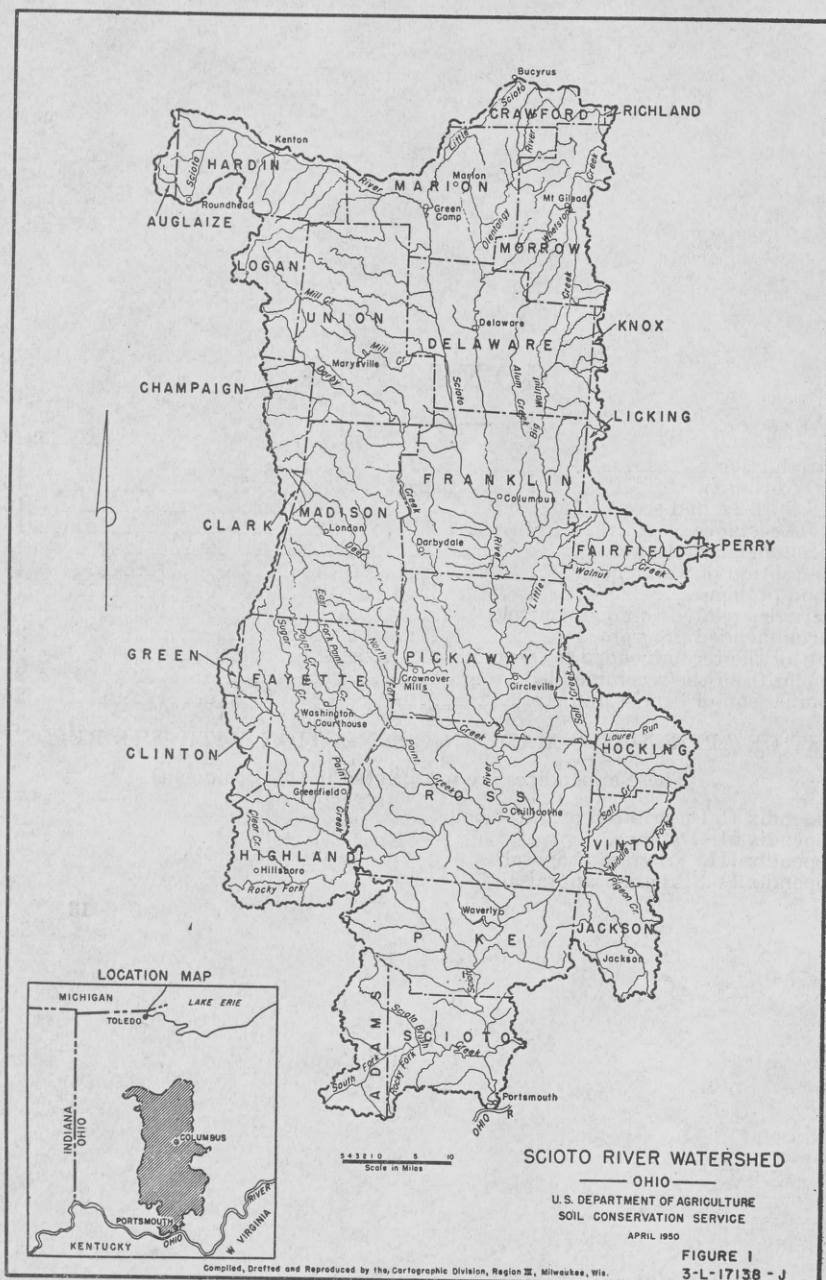
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### LIST OF APPENDIXES MADE IN CONNECTION WITH THE REPORT

(These appendixes are not printed in this document)

- Appendix I. Description of watershed.
- Appendix II. Damage.
- Appendix III. Program proposal.
- Appendix IV. Program appraisal.





# SCIOTO RIVER WATERSHED, OHIO

## INTRODUCTION

*Authority.*—This interim report is submitted under the provisions of the act approved June 22, 1936 (49 Stat. 1570), as amended and supplemented.

*Purpose and scope.*—The purpose of this interim report is to outline a program of runoff and water-flow retardation and soil-erosion prevention for the Scioto River watershed in Ohio, a subwatershed of the Ohio River watershed, and to present recommendations for its installation and maintenance, together with an analysis of the costs and benefits thereof.

The Scioto River, a tributary of the Ohio River, has a drainage area of 6,510 square miles. It is anticipated that surveys will be conducted and reports submitted on the remainder of the Ohio River watershed at a later date under authority contained in the above acts.

*Assistance.*—The following Federal and State agencies assisted by providing information necessary to the preparation of this report. Department of the Army, Corps of Engineers; Ohio State University; Ohio State Experiment Station; Ohio State Highway Department; Scioto-Sandusky Conservancy District, Ohio<sup>1</sup>; and the Ohio State Department of Natural Resources.

## RECOMMENDATIONS

It is recommended that a program of runoff and water-flow retardation and soil-erosion prevention be installed during a 20-year period in the Scioto River watershed in Ohio at an estimated cost to the Federal Government of \$11,615,210, and at an estimated cost of \$8,692,780 or its equivalent to local interests<sup>2</sup>, making an estimated total cost of \$20,307,990 for the installation of the recommended program.

The program will be operated and maintained at an estimated annual cost of \$102,340 to the Federal Government and at an estimated annual cost of \$4,627,532 or its equivalent to local interests, making an estimated total annual cost of \$4,729,872 for operating and maintaining the recommended program. Of the amount to be expended by local interests, it is expected that \$4,507,737 or its equivalent will be expended by landowners and operators for maintaining conservation measures and for the increased cost of operating a more profitable system of conservation farming and woodland management; and that \$119,795 will be expended by a local agency or agencies

<sup>1</sup> Organized under the Ohio State Conservancy Act of 1941.

<sup>2</sup> Labor, materials, equipment, land, easements, rights-of-way, and other contributions in lieu of cash payments.



acceptable to the Secretary of Agriculture for operating and maintaining those installations which are not considered a part of normal farm operations.

The program herein recommended includes the intensification, acceleration, and adaptation of certain activities under current programs of the Department of Agriculture, and additional measures not now regularly carried out in such programs, all of which are necessary to complete a balanced runoff and water-flow retardation and erosion-control program for the watershed. It is recommended that the Secretary of Agriculture be authorized to carry out this program. Although the current activities of the Department primarily related to the Flood Control Act are not included in the program herein specifically recommended, this program is based on the continuation of such current activities at least at their present level.

The recommended program includes measures and practices that contribute directly to substantial and measurable reductions in floodwater and sediment damage. The measures that will accomplish this objective are woodland protection, including adequate fire control and protection from overcutting and logging damage; woodland establishment and reinforcement; land acquisition; land-use conversion and adjustments in cropping pattern; pasture establishment; terracing; stabilization of water disposal systems; diversions; stabilizing and sediment control structures with floodwater detention features; upstream floodwater-retarding structures; and tributary channel improvement.

Technical services will be made available for planning and applying the necessary land-use adjustments, for planning and applying conservation measures on the watershed, and for integrating the measures included in the recommended program. Educational assistance will be provided to facilitate the installation of the recommended program.

The Secretary of Agriculture may construct such buildings and other improvements as are needed to carry out the measures included in the recommended program.

The Secretary of Agriculture may make such modifications or substitutions of the measures described herein as may be deemed advisable due to changed physical or economic conditions or improved techniques whenever he determines that such action will be in furtherance of the objectives of the recommended program.

The authority of the Secretary of Agriculture to prosecute the recommended program shall be supplemental to all other authority vested in him, and nothing in this report shall be construed to limit the exercise of powers heretofore or hereafter conferred on him by law to carry out any of the measures described herein or any other measures that are similar or related to the measures described herein.

It is estimated that the recommended program will yield an annual benefit of \$19,997,967. Based on prices and costs expected to prevail under intermediate employment levels during the period 1955 to 1965 the ratio of the average annual benefit to the average annual cost is 3.4 to 1.0.

It is anticipated that the recommended program will be installed under cooperative arrangements with individuals, and with State and local governments, soil conservation districts, or other agencies acceptable to the Secretary of Agriculture.

## DESCRIPTION OF WATERSHED

The Scioto River rises in eastern Auglaize County in the north central part of Ohio. From its source it flows eastward about 60 miles and then in a southerly direction to enter the Ohio River at Portsmouth, Ohio (fig. 1).

The watershed includes all or parts of 29 counties. It is somewhat rectangular in shape, with a width of about 50 miles east and west and a length of about 135 miles north and south. The total watershed area is 6,510 square miles.

In the northern three quarters of the watershed the soils are derived from glacial debris. Most of this area is of low relief. Elevations range from 600 feet above sea level in Franklin County to 1,500 feet in the northern part of the watershed.

In the southern quarter of the watershed the soils are derived from residual sandstones and shale, and this area is of moderate to steep relief. Elevations range from 1,300 feet above sea level in the uplands to about 475 feet at Portsmouth.

The farm population, based on the 1945 agricultural census, is estimated to be 120,633. According to this census, 25.3 percent of the farms are operated by tenants, 63 percent by full owners, 10.9 percent by part owners, and 0.8 percent by managers. Approximately 90 percent of the total area is in farms. There are about 49,650 acres of forest land in public ownership. The average size of the 29,040 farms in the watershed is 129 acres. The watershed is situated in a region classed as general livestock-grain farming. Dairy and hog production are either first or second in importance in most of the counties.

## FLOOD PROBLEMS

Rains in the Scioto River watershed are of two general types: Localized thunderstorms and widespread storms of long duration. Rarely do the localized storms result in floods on the principal tributaries; however, on streams such as Salt Creek and Rocky Fork (fig. 1) considerable floodwater damage results from flash floods. The northern portion of the watershed is flat with generally poor drainage. Floods in this area are usually caused by widespread storms.

The flood problem has been aggravated by intensive farming of cropland to row crops and small grain, and overgrazing of pasture; and by burning, grazing, and overcutting of woodland. It is estimated that approximately 85 percent of the sediment comes from sheet erosion. Gully erosion, streambank erosion, floodplain scour, and roadside erosion are other sources of sediment.

Serious erosion problems exist in many parts of the watershed. On the upland, sheet erosion has removed an average of 2.6 inches of topsoil, and gully erosion is damaging approximately 300 acres each year. In addition to this erosion damage the development of gully systems has increased the difficulty of operation on parts of some agricultural units to the extent that they are no longer used for cropland. Erosion damage on bottom land includes stream-bank erosion and flood plain scour. Stream-bank erosion has damaged over 15,000 acres of bottom land along the main stem of the Scioto and its tributaries, an estimated 63 percent. The present rate of bank erosion is

approximately 272 acres per year. Floodwaters have scoured and cut channels in the bottom land. Approximately 30,500 acres of land have been damaged by an average of about 26 percent.

Floodwater damage to crops and pastures on the bottom lands of the tributaries is most serious when inundation occurs during the growing season. Additional floodwater damage includes fence loss, debris accumulation, damage to public-utility installations, transportation facilities, and similar items.

Sediment damage to land includes reduction of soil fertility by infertile overwash and impairment of natural bottom land drainage (swamping). Infertile sediment has reduced crop yields by an estimated 11 percent on more than 61,000 acres of bottom land along the main stream and tributaries. Damage from swamping has resulted in a 32-percent reduction in yield on more than 14,600 acres.

In less than 3 years (November 1946 to June 1949) Lake Madison lost 10.8 percent of its original capacity. There are over 800 other reservoirs, lakes, and farm ponds in the watershed with drainage areas ranging up to 367 square miles, which are losing storage capacity from sedimentation. These include water-supply and recreational reservoirs, and farm ponds.

Water-treatment costs are high in four municipalities because of suspended sediment carried by floodwater.

Sediment damage occurs on approximately 1,100 miles of railroads and about 12,300 miles of State, county, and local roads. Sediment deposits are causing damage to approximately 2,540 miles of drainage ditches.

In addition to the direct floodwater and sediment damage to property, indirect damage is important. Some of the more evident forms of indirect damage are interruption, dislocation, and breakdown of trade and transportation; care and rehabilitation of flood victims; cost of sanitation and restoration of public works; and other demands on public funds and services. Less apparent, but equally important, are losses that result from migration and shifting of population; decadence and impoverishment of communities; destruction of balances, integrations, and other interrelations both in business and agriculture; disruption of educational facilities and the administration of other public institutions; weed contamination; spreading of livestock diseases; and other dislocations in social and economic relations within the region.

Other damages caused by floodwater which were not evaluated in monetary terms in this report include loss of life, illness, insecurity of property and income, and disturbance of the general economic and social activity of the population.

The monetary evaluation of the estimated average annual damages is shown in table 1. These damages do not include those which will be prevented by current or authorized programs of other public agencies.

#### ACTIVITIES RELATED TO FLOOD CONTROL

The Department of the Army, Corps of Engineers, has prepared a report on preliminary examination of the Scioto River, Ohio, September 12, 1916, which was published as House Document 1792, Sixty-fourth Congress, second session. In this report, flood-protection plans were investigated to determine the extent to which the United States should cooperate with the State, local communities, and



other interests in carrying out such plans. Following the preliminary examination report a survey report on the Scioto River, Ohio, April 30, 1941, was prepared. Results of the study indicated that the most practical plan of flood-control improvement at that time involved the construction of Delaware, Paint Creek, and Rocky Fork Reservoirs, and local protection works for Chillicothe. Definite project reports have been prepared for Delaware and Rocky Fork Reservoirs. Delaware Reservoir is practically completed and Rocky Fork is under construction.

The Department of Agriculture through four of its bureaus—Production and Marketing Administration, Extension Service, Forest Service, and the Soil Conservation Service—is presently engaged in installing some works which cause substantial reduction in floodwater and sediment damage. An appraisal was made of the work of these agencies in the watershed. It was found that the portions of the programs of these agencies which involved intensity of use of land, terracing, contouring, strip cropping, pasture establishment, forest planting, and establishment of stable waterways have substantial effects on floodwater and sediment damage.

TABLE 1.—*Summary of average annual damages, Scioto River watershed, Ohio (1949 prices)*

	Average annual damage
Erosion damage:	
Sheet erosion.....	\$947, 214
Gully erosion.....	226, 993
Streambank erosion.....	41, 158
Floodplain scour.....	28, 135
Subtotal.....	1, 243, 500
Damage due to inundation:	
Agricultural.....	830, 467
Nonagricultural.....	398, 170
Subtotal.....	1, 228, 637
Sediment damage:	
Infertile overwash.....	38, 963
Swamping.....	17, 962
Reservoirs and ponds.....	154, 359
Water filtration.....	13, 918
Transportation facilities.....	441, 581
Drainage ditches.....	479, 885
Corps of Engineers: Proposed program.....	42, 854
Subtotal.....	1, 189, 522
Total.....	3, 661, 659

The agricultural conservation program of the Production and Marketing Administration in the watershed is an effort on the part of the Department of Agriculture to secure the cooperation of farmers in conserving and restoring the soil, water, and woodland resources. The 1950 agricultural conservation program provides six major groups of practices through which farmers can help to protect the soil and water resources.

The agricultural extension agents of the Extension Service form a connecting link between farm people and the research agencies, the State experiment stations, and the Department of Agriculture. These agents carry on demonstration work and use many other means of

education, including bulletins, newspaper articles, motion pictures, radio talks, exhibits, meetings, and discussion groups.

The Forest Service, through its Wayne-Hoosier National Forest, and the State division of forestry have been participating in the programs concerned with protecting woodland from fire and overcutting and logging damage. Approximately 247,737 acres of woodland are being adequately protected from fire under these programs.

The Soil Conservation Service, working through the established soil conservation districts in the watershed, has been providing technical services and necessary information for the planning and installation of measures which aid in runoff reduction and prevention of soil erosion.

Through these agencies the Department of Agriculture is now expending \$267,805 annually to accomplish this work.

Soil conservation districts have been established in all of the counties within the watershed. A land use and management program is being developed by these districts. These districts, organized by the farmers, make it possible for the farmers to work together for mutual benefit in the establishment of soil conservation practices.

Civilian Conservation Corps, Works Progress Administration, and Soil Conservation Service demonstrations were carried on in the watershed for a number of years to demonstrate measures for soil and water conservation in this area.

The Scioto-Sandusky Conservancy District, Ohio, is preparing a comprehensive plan for runoff and water-flow retardation and soil-erosion prevention on the lands within the drainage areas of the Sandusky and Scioto Rivers. This Initial Official Plan of the Conservancy District will recommend the construction of one storage reservoir, and seven flood-control and water-conservation reservoirs, supplemented by local flood-protection improvements at Fremont, Columbus, and Chillicothe and by eight local rural levee projects along the Scioto River below Columbus.

The Ohio State Department of Natural Resources furnishes technical assistance to the woodland owners, supplies trees for the establishment of forest cover, and protects woodland against fire. It is also engaged in the study of ground-water supplies, industrial water supplies, flood damages, reservoir sedimentation, and other water problems, and has published numerous valuable reports on these subjects.

The city of Columbus made a thorough study following the 1913 flood and has done considerable work in the vicinity of Columbus to reduce the flood hazard.

#### RECOMMENDED PROGRAM

The recommended program of runoff and water-flow retardation and soil-erosion prevention includes the following measures:

##### *Woodland protection*

Adequate fire control will be provided on 564,091 acres of woodland, including the area recommended for purchase, to increase infiltration and the water-holding capacity of the forest soils, and to reduce sediment production.

Protection against overcutting and logging damage, along with other proper management practices, will be provided on 731,631



acres of forest land to correct abuses which have converted woodland to flood and sediment source areas.

#### *Woodland establishment and reinforcement*

Land suited to woodland usage and now used for this purpose will remain in woodland. Tree planting is necessary on certain woodland and cleared areas to obtain more rapid and effective erosion control and reduction of flood runoff. Planting will be done only where seed trees are not available or where reseeding is inadequate or too slow to restock the area sufficiently to obtain rapid soil protection. Two types of planting are involved. Woodland establishment involves full planting of trees on open land converted to forest, or denuded land. Woodland reinforcement consists of planting bare spaces in open forest lands. Planting is recommended on 38,922 acres.

#### *Land acquisition*

About 30,000 acres of watershed land in poor physical condition will be acquired by the Federal Government. These lands are either now abandoned or are undergoing abandonment. They are in general unsuited for agricultural purposes and are now very slowly reverting to forest. The past treatment of most of these lands has been such that they are now a critical source of flood runoff and sediment. Because of their poor physical condition, owners cannot afford to install the measures necessary for their restoration to a condition which will prevent them from continuing as sources of debris and high rates of runoff. The lands are located within a portion of the McArthur purchase unit; they are the most critical lands in this portion of the unit. Acquisition of these lands for flood-control purposes will permit action on them to be integrated with other measures in the watershed.

#### *Testing the effectiveness of measures*

Such investigations and evaluations of the effect of the measures will be made as are necessary to adapt practices and measures to watershed problems for accomplishing the objectives of the program in an efficient manner.

#### *Land-use conversions and adjustments in cropping pattern*

Table 2 shows the land-use changes necessary in order to use the land in accordance with its capability. Present methods of farming have caused removal of topsoil and have depleted the soil of organic matter and nutrients, thereby causing inadequate vegetative protective cover which results in low infiltration rates, rapid and excessive runoff, and land deterioration. Through the recommended conversions of land use with the necessary associated measures, the soil erosion and runoff from the land can be reduced, thereby causing substantial reduction in floodwater and sediment damages.

Strip cropping, which is the use of alternate meadow crops with either clean-tilled or small grain crops in contoured bands on a hillside, will be applied on 6,951 acres to reduce the length of slope over which surface water may travel on unprotected (clean-tilled or small grain) land. When applied in combination with the proper intensity of cropping pattern, soil and water losses are reduced.

Contouring is farming land on the contour. Each crop row provides a miniature barrier that impounds the water it collects. Contouring of clean-tilled and small grain crops greatly reduces the soil and

water losses when these crops are used in the proper sequence with meadow. This practice will be applied on 96,040 acres.

In order to make the recommended adjustments it will be necessary to build and relocate fences. Living fence, consisting mainly of multi-flora rose which is climatically adapted for all parts of the watershed, will be included as a part of the farm-fencing system wherever it is feasible. About 3,561 miles of fence will be relocated.

#### *Pasture establishment*

Pasture will be established on 17,217 acres of cropland and idle land to reduce damaging runoff and sedimentation. Suitable seedings of legumes and grasses are needed with sufficient application of fertilizer and lime to provide for the establishment of this pasture.

#### *Terracing*

The regulation of both the concentration and velocity with which free water moves over the surface of the ground may be accomplished by controlling the length of slopes over which the water moves. Where slopes are sufficiently long or steep to favor damaging concentrations and velocities they can be shortened by the use of appropriate mechanical barriers. Terraces are the most effective barriers used for this purpose, and with their use, proper use of the land can be realized with the least disturbance to the economy of the average farm.

TABLE 2.—*Land-use changes, Scioto River watershed, Ohio*

	Land use			Land use	
	Present	Recom- mended		Present	Recom- mended
	<i>Acres</i>	<i>Acres</i>		<i>Acres</i>	<i>Acres</i>
Clean tilled.....	821,708	689,262	Woodland.....	828,096	811,828
Small grain.....	621,067	630,448	Other.....	231,192	160,214
Hay and rotation pasture..	529,480	979,310			
Permanent pasture.....	718,207	478,688	Total.....	3,749,750	3,749,750

By terracing, a field is divided into several small watersheds. The short slopes thus formed, plus the use of a cropping plan, soil-treatment and cultural practices adapted to that field, will allow only a minimum of runoff water to attain a scouring velocity. Terraces will be constructed on 472,778 acres of cropland to conduct runoff at nonerosive velocities to stabilized outlets and watercourses. The installation of these terraces will permit the most intensive use of cropland consistent with attaining the objectives of the program. Due to the nature of the soil, only graded terraces have been considered. Such terraces require outlets, either natural waterways or the constructed (artificial) type. Without these outlets which are discussed in subsequent paragraphs the amount of terracing in the recommended program would be limited.

#### *Stabilization of water-disposal systems*

Adequate systems for the disposal of runoff water are a necessary part of the program to reduce floodwater, erosion, and sediment damage. Minor watershed waterways will be stabilized to provide for the safe disposal of runoff water. These waterways provide outlets for terrace systems, eliminate noncrossable gullies so that fields can be

contoured or strip-cropped, and reduce the sediment contribution from gullies. Some of the waterways will be established by the blading in of gullies and seeding to the suitable grass mixture. In some cases it will be necessary to construct small stabilizing and sediment-control structures to supplement the proposed sloping and seeding program of waterway stabilization. These structures will reduce floodwater velocities so that the waterways may be protected with vegetation. About 5,019 miles of water-disposal systems will be stabilized.

#### *Diversions*

Diversions will be built above actively advancing overfalls of small gullies to direct the runoff water into stabilized waterways. In some instances water from several gullies will be concentrated into one channel which has been stabilized by structures or vegetation. Diversions will also be used to divert excess runoff from upland fields to adequate waterways in order that local flooding can be prevented on bottom land directly below those fields and to divide long slopes of fields which are too irregular to terrace. About 284 miles of diversions will be constructed.

#### *Stabilizing and sediment-control structures with floodwater detention features*

The stabilizing and sediment-control structures with floodwater-detention features serve a dual purpose of waterway stabilization and regulation of runoff. These structures are closely related to the recommended land-treatment program for the contributing watersheds which range in size from approximately 40 to 200 acres. The principal type of structure recommended is the drop inlet spillway. These structures are designed to temporarily impound runoff water behind an earth dam and discharge the runoff slowly, thereby reducing inundation damage immediately below the structure site. The structure will also reduce gully erosion and sediment damage. Approximately 597 of these structures will be constructed.

#### *Upstream floodwater-retarding structures*

Three upstream floodwater-retarding structures will be located in the headwater tributaries and will be designed to furnish protection for flood-plain areas by providing temporary storage for runoff. They will reduce inundation damage and permit a more intensive use of the protected bottom land. Drainage areas above the structures average about 5 square miles each. These structures will be earth-fill dams through which a small, low elevation outlet conduit uncontrolled by gates or valves will be constructed to draw down the temporary storage. A spillway adapted to site conditions and meeting adequate design criteria will be used to provide an outlet for flood flow in excess of a storage capacity of approximately 3 inches of runoff.

#### *Tributary channel improvement*

Approximately 250 miles of tributary channels will be improved to reduce damage from stream-bank erosion and flood-plain scour. This type of control measure will reduce bank cutting and sediment damage, and will also reduce flood stages by increasing channel efficiency through removal of objectionable debris. Protection will be provided for valuable cropland areas, highways, railroads, bridges, utilities,

farm buildings, and other high-value improvements being endangered by stream-bank cutting as well as high sediment-producing areas. Bank cutting is often an important source of damaging sediment.

#### *Educational assistance*

Landowners and operators and others in the watershed will be furnished educational assistance relative to the need for the recommended program and its purpose and objectives. Information will be supplied as to the manner in which landowners and operators now obtain services and assistance that are available through the various governmental agencies, and how they can and should, by their own efforts, contribute successfully and most economically to the accomplishment of the over-all objectives. Intensified educational efforts will be directed to familiarizing farmers with the specific practices and measures essential to runoff and waterflow retardation and soil-erosion prevention, how to install and apply those measures not requiring the detailed assistance of a specialized technician, how to maintain such installations and measures, and how to integrate all into the soundest farming system to produce the greatest benefit over a long period of time.

The Department is committed to a watershed and subwatershed approach in carrying out its responsibilities in the interest of flood control. It is essential that educational assistance provided under this program be directed toward furthering the specific objectives of flood-water and sediment damage reduction and that it be fitted as to method and synchronization into subwatershed operations activities.

#### *Technical services*

Technical services will be provided for planning and applying woodland improvement measures and management practices for watershed protection, for planning and applying land use adjustments, for planning and applying conservation measures on the farm, and for integrating the installation of individual measures into a proper combination to achieve the most effective program of runoff and waterflow retardation and soil-erosion prevention. Those services are required to assist the people in the watershed in installing the recommended measures on their land and in adopting the recommended practices for their farm and woodland operations.

#### COST OF THE RECOMMENDED PROGRAM

The estimated cost of installing the recommended program is shown in table 3. Approximately 30 percent of the estimated installation cost of the recommended program is for technical services, educational assistance, and the administration of direct aids. Non-Federal public agencies will bear 50 percent of the cost of educational assistance and 50 percent of the cost of technical services on privately owned forest land.



Of the total installation cost of \$20,307,990, it is estimated that the Federal Government will expend \$11,615,210; non-Federal public agencies, \$1,914,707; and private interests, \$6,778,073.

Of the average annual cost of \$4,729,872 for operating and maintaining the program, it is estimated that the Federal Government will expend \$102,340; non-Federal public agencies, \$119,795; and private interests, \$4,507,737.

#### BENEFIT FROM THE RECOMMENDED PROGRAM

The benefit that will result from the installation of the recommended program includes reduction in erosion, inundation and sediment damage, increased production of bottomlands, and increased income to landowners and operators in the watershed. The full attainment of the benefit evaluated in this report is dependent upon the cooperation and support of farm owners and operators and local governments in installing and maintaining the recommended practices and measures. The estimated average annual monetary value of this benefit is shown in table 4.

The benefits due to the reduction of the erosion, inundation, and sediment damages accrue by virtue of reducing and retarding runoff at its source. This reduces the production of sediment by controlling erosion and regulates flood flows in the tributary streams. It is estimated that erosion damage will be reduced by 79 percent, inundation damage by 8 percent, and sediment damage by 55 percent. Increased production on bottomland results from measures which make possible more intensive use of these lands. Additional benefits will accrue in the form of increased crop yields following installation of the land treatment measures.

TABLE 3.—*Estimated cost of the recommended program, Scioto River watershed, Ohio (1949 prices)*

Item	Unit	Quantity	Installation cost
Woodland protection:			
Adequate fire control.....	Acre.....	564,091	<sup>1</sup> \$234,386
Protection from overcutting and logging damage.....	do.....	731,631	<sup>1</sup> 3,623,821
Woodland establishment.....	do.....	3,614	84,969
Woodland reinforcement.....	do.....	35,308	583,680
Land acquisition.....	do.....	30,000	450,000
Testing the effectiveness of measures.....	Watershed.....		15,000
Land-use conversion and adjustments in cropping pattern.....	do.....		3,669,319
Pasture establishment.....	Acre.....	17,217	665,754
Terracing.....	do.....	472,778	4,765,103
Stabilization of water-disposal systems.....	Mile.....	5,019	3,241,494
Diversions.....	do.....	284	145,812
Stabilizing and sediment-control structures with floodwater-detention features.....	Each.....	597	1,722,995
Upstream floodwater-retarding structures.....	do.....	3	251,200
Tributary channel improvement.....	Mile.....	250	854,457
Total.....			20,307,990

<sup>1</sup> Includes cost of operation and maintenance during period of installation.

TABLE 4.—*Estimated average annual benefit from the recommended program, Scioto River watershed, Ohio (1949 prices)*

Reduction in erosion damage:	
Sheet erosion.....	\$824, 084
Gully erosion.....	192, 789
Streambank erosion.....	5, 713
Floodplain scour.....	5, 278
Subtotal.....	1, 027, 864
Reduction in damage due to inundation:	
Agricultural.....	71, 435
Nonagricultural.....	5, 716
Subtotal.....	77, 151
Reduction in sediment damage:	
Infertile overwash.....	18, 577
Swamping.....	7, 236
Reservoirs and ponds.....	74, 026
Water filtration.....	5, 099
Transportation facilities.....	261, 342
Drainage ditches.....	181, 045
Corps of Engineers proposed program.....	17, 491
Subtotal.....	564, 816
Conservation benefit.....	18, 292, 509
Increased production on bottom lands.....	35, 627
Total.....	19, 997, 967

In addition to the monetary benefits shown in table 4, there will be unevaluated benefits such as increased food and improved shelter for wild fowl and game animals; a greater population of fish as a result of clearer streams of more even flow; improved recreational facilities; and alleviation of illness, hardship, and disease epidemics following flood disaster.

#### COMPARISON OF BENEFIT AND COST

Based on prices and costs expected to prevail under intermediate employment levels during the period 1955 to 1965, the ratio of the average annual benefit to the average annual cost is 3.4 to 1.0.